



# AIDA

Advanced European Infrastructures  
for Detectors at Accelerators

## Task 8.2.1 Low energy test beam Milestone 27

AIDA 1<sup>st</sup> General Meeting, DESY  
27 March 2012  
Paul Soler



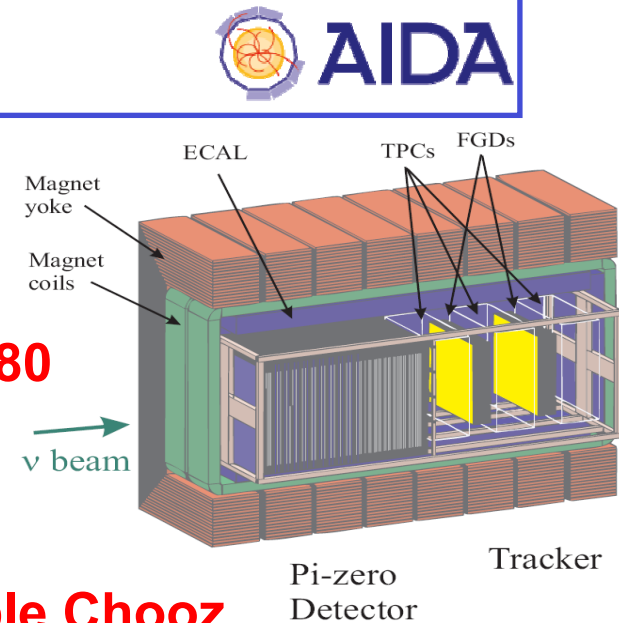
University  
of Glasgow

# Motivation

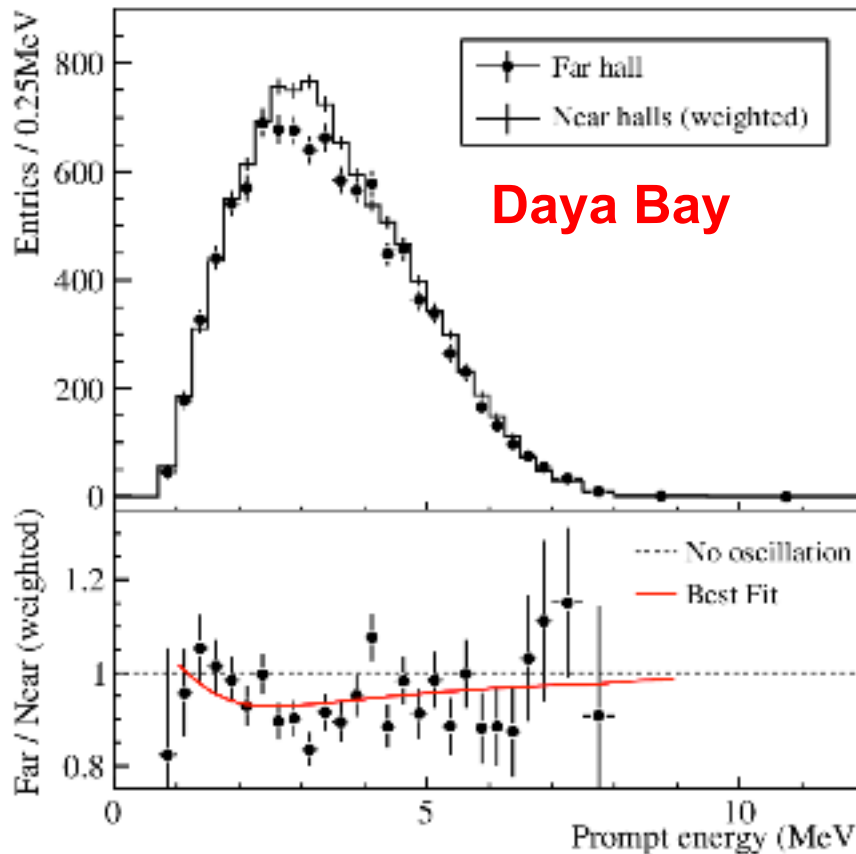
- Recent discovery of  $\theta_{13}$ , by Daya Bay with extra hints by T2K and Double Chooz:

$$\sin^2(2\theta_{13}) = 0.092 \pm 0.016_{stat} \pm 0.005_{syst}$$

**T2K ND280**

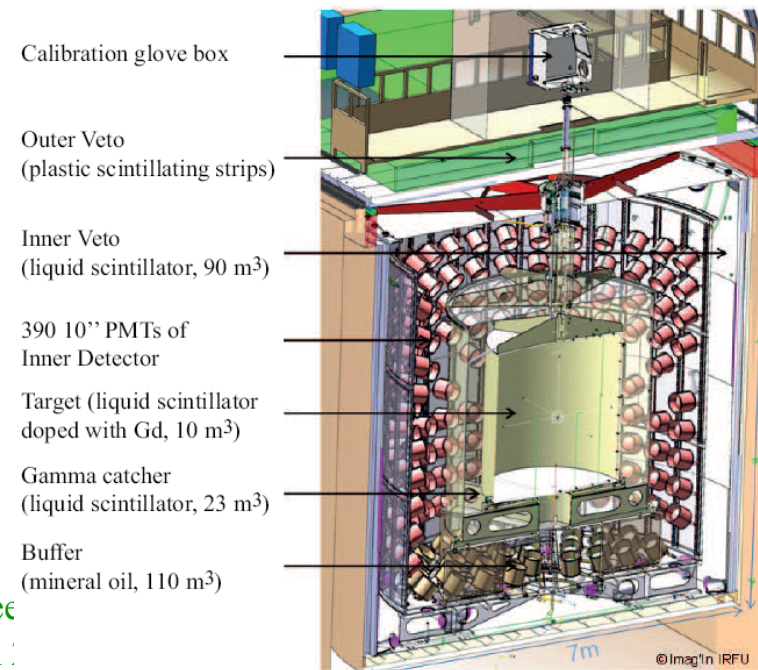


**Double Chooz**



**Daya Bay**

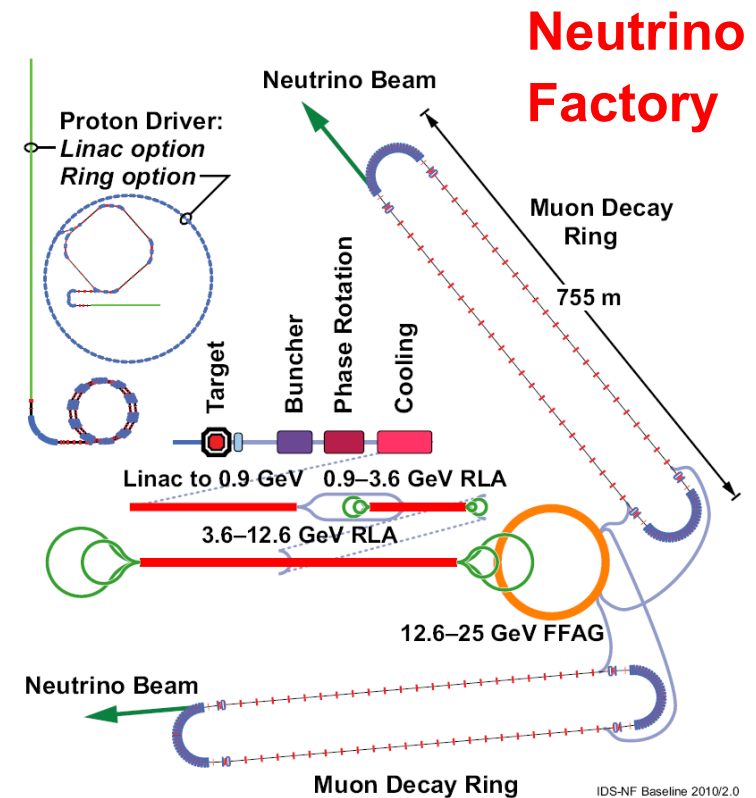
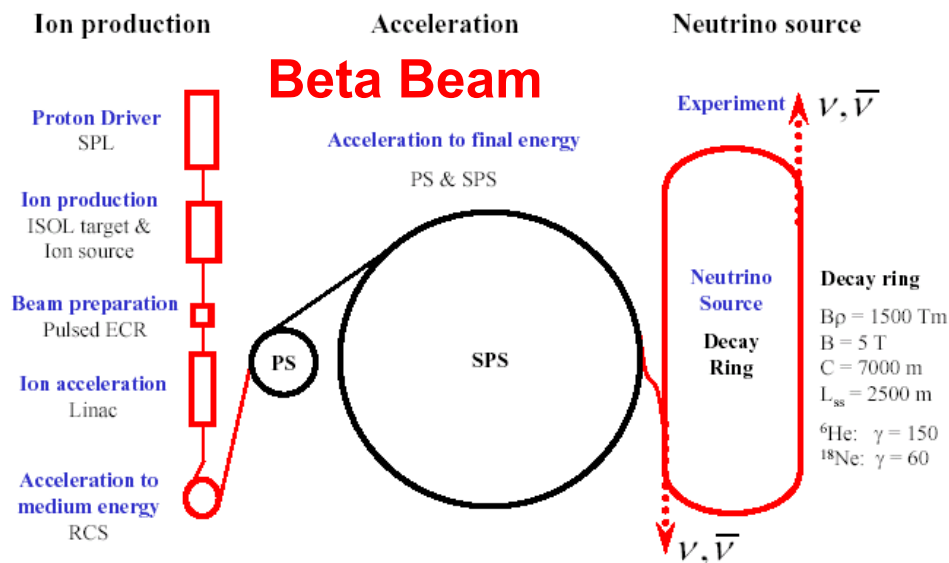
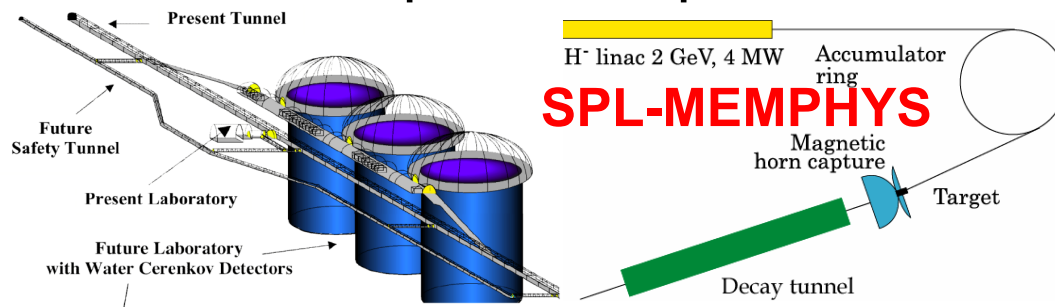
neral Mee  
8 March



# Motivation



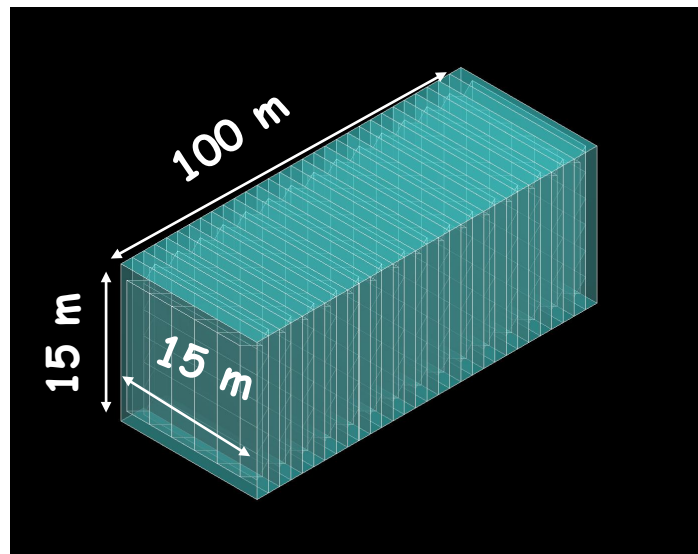
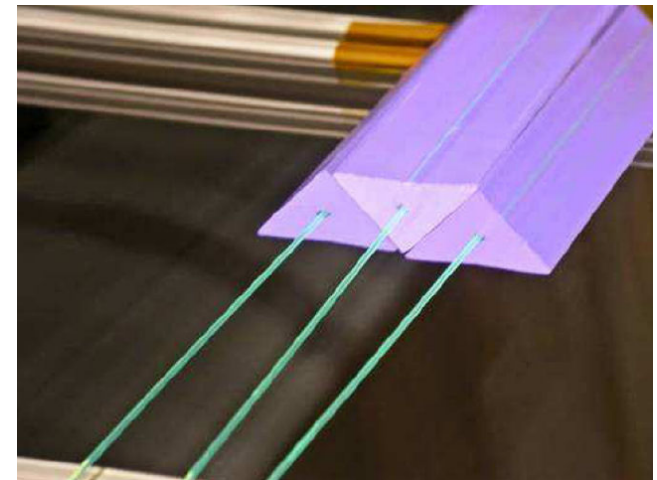
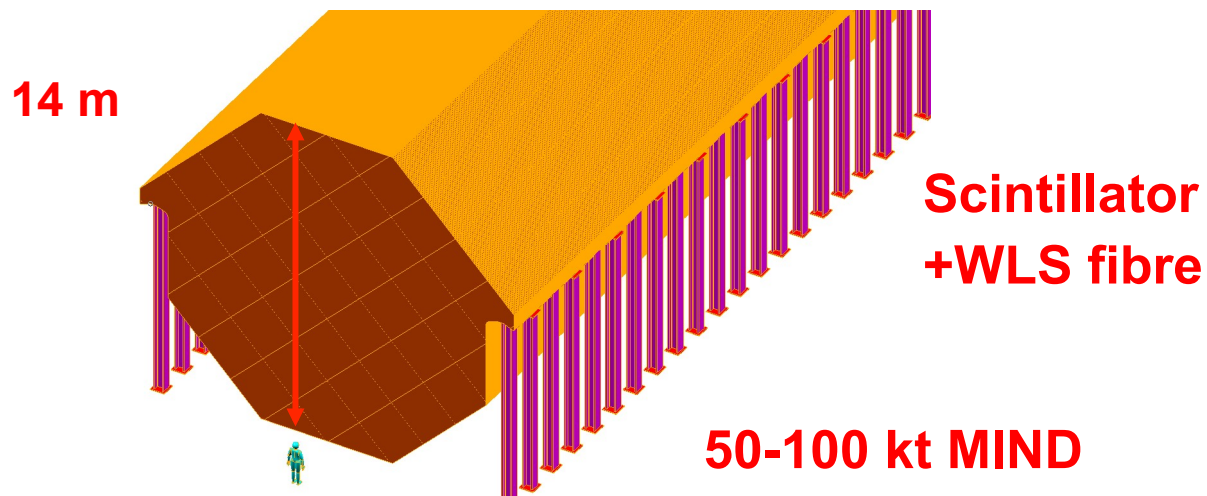
- ❑ Large value of  $\theta_{13}$  improves chances of making further discoveries: mass hierarchy (is  $m_3 > m_1, m_2$  or  $m_3 < m_1, m_2$ ?) and CP violation (measurement CP phase  $\delta$ )
- ❑ Three options: super-beam, beta beam, neutrino factory



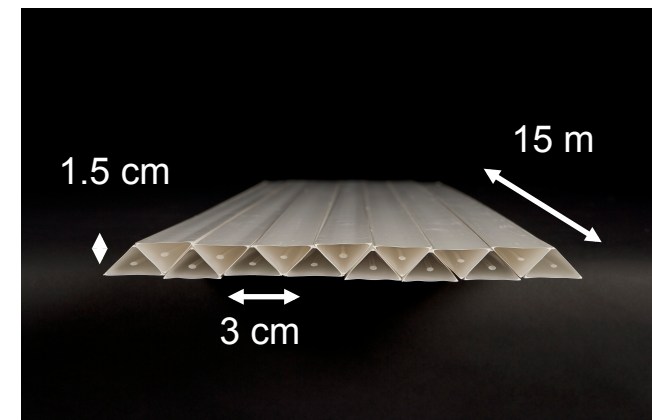
# Neutrino detectors



- ❑ Neutrino factory detectors: Magnetised Iron Neutrino Detector (MIND) with iron+scintillator and TASD



**Totally  
Active  
Scintillation  
Detector  
(TASD)**



AIDA General Meeting,  
DESY, 28 March 2012

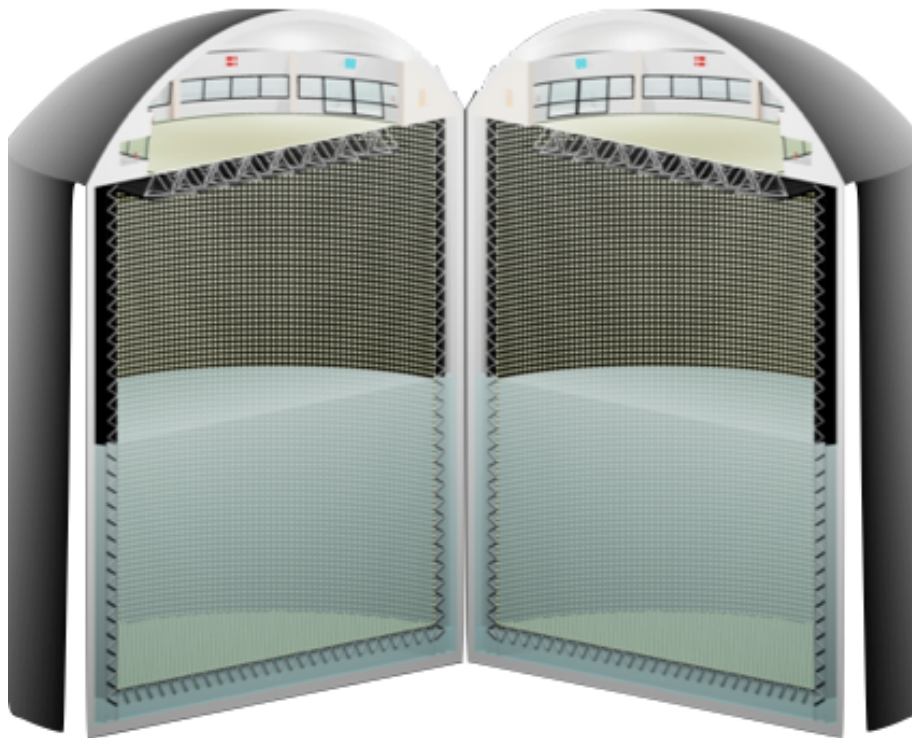


# Neutrino detectors

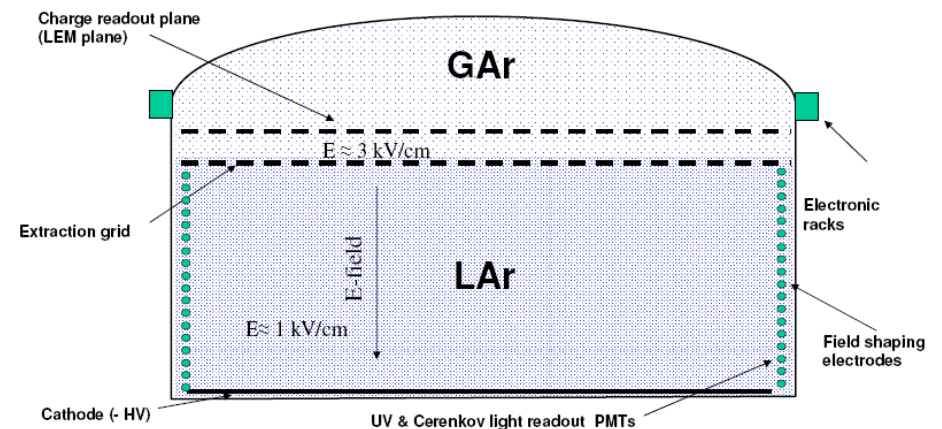


- ❑ Super Beam and Beta Beam detectors: water Cherenkov and/or liquid Argon (LAr) detectors

**MEMPHYS**



**GLACIER**



**Studied under LAGUNA-LBNO**

### ❑ Task 8.2.1:

- Develop test beam area in H8 beamline (North Area at CERN)
- A study of the upgrade of the H8 beam to deliver low energy electrons, muons and hadrons for neutrino experiment prototypes

### ❑ Task 8.5.2:

- Build a Magnetised Iron Neutrino Detector (MIND) prototype
- Install a Totally Active Scintillating Detector prototype inside the Morpurgo magnet
- This will allow to test both electron and muon charge ID in the same test beam
- Apart from the equipment, detectors and electronics we would also need a DAQ (would the common DAQ be suitable?)
- MIND prototype becomes a facility for other users in the test beam

# Milestones and deliverables



- ❑ Task 8.2.1: design study for low energy particle beam line
  - MS27: Specifications for beam line fixed (month 12) **achieved**
  - D8.3: Design study on low energy beam line: Design and implementation study on a low energy beam to the range of 1 (or possibly less) and 10 GeV (month 26)
- ❑ Task 8.5.2: T ASD and MIND
  - MS28: Design of T ASD and MIND (month 26)
  - MS36: Installation of T ASD and MIND (month 33)
  - D8.11: Infrastructure performance and utilization - T ASD and MIND are constructed and tested for their performance. (Will there be test beams in 2014?)

# H8 beamline

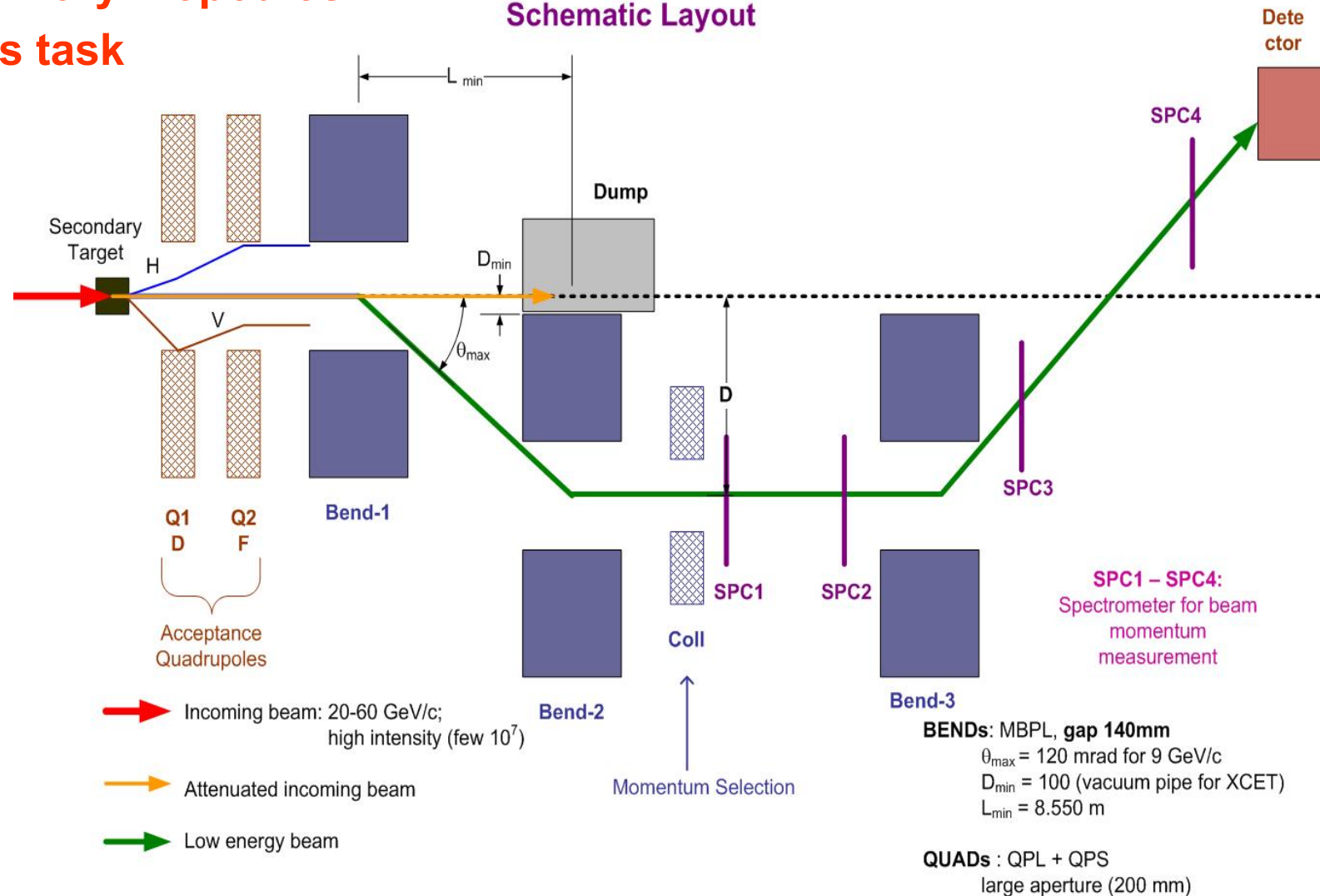


## Feasibility study and cost of low energy beamline

Ilias Efthymiopoulos  
leads task

### H8 Low Energy Muon Beam

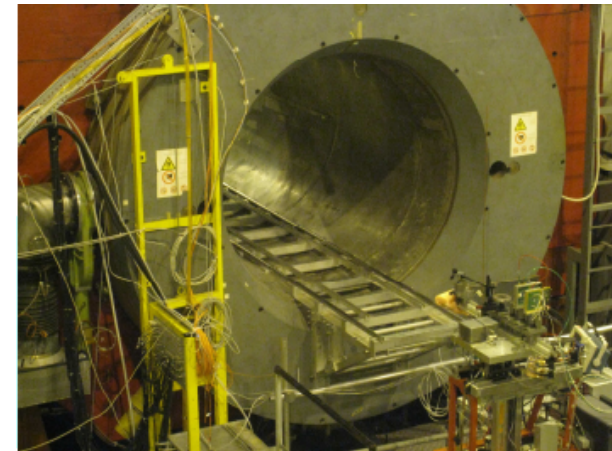
#### Schematic Layout



## H8 beamline specification



- ❑ Specifications of low energy test beam area in H8:
  - Measurement of electron charge ID and stopping power in TASD: use Electron-Muon Ranger (EMR) in MORPURGO magnet in the North Area at CERN (1.6 T).
  - Electron beam from 0.5 - 5 GeV/c (up to 9 GeV/c)
  - Measurement of muon charge ID in MIND with correct-sign background rejection of one part in  $10^4$
  - Muon beam between 0.8 - 5 GeV/c (perhaps up to 9 GeV/c).
  - Reconstruction of the hadronic shower for CC vs NC selection: hadron beam 0.5 - 9 GeV/c
  - Particle flux (muons) of 1-2 kHz for each given momentum, in spot size of  $10 \times 10 \text{ cm}^2$



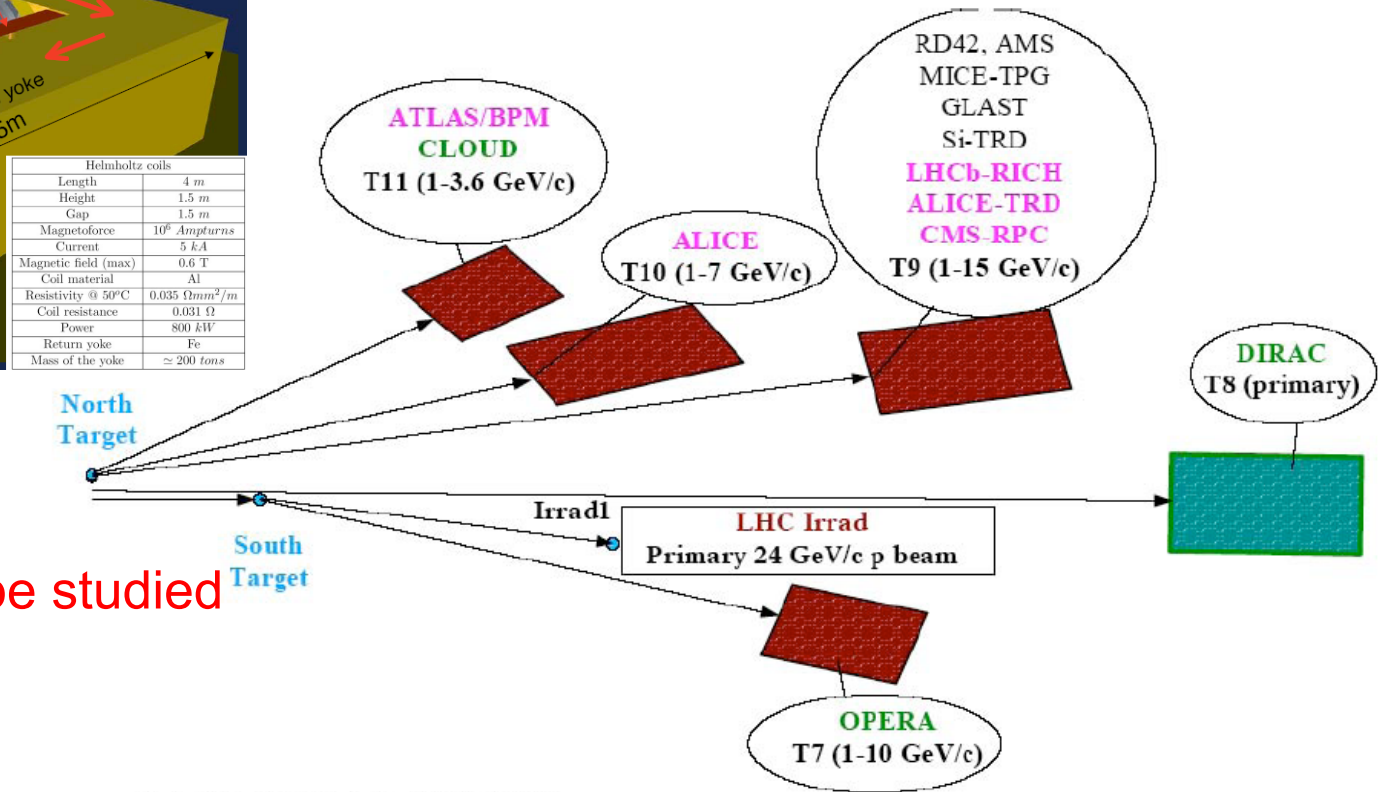
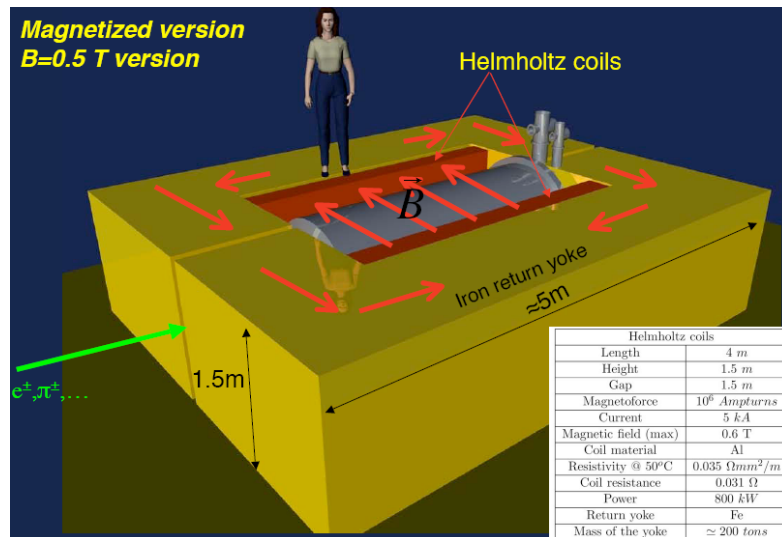
AIDA General Meeting,  
DESY, 28 March 2012



# East Area



- Another possibility is the East Area at the CERN PS, with a fixed dipole magnet for dedicated Neutrino Detector R&D



This option will also be studied within task 8.2.1

**EAST AREA LAYOUT**  
(2006 Situation)

Need very low intensity  $\approx 1000$  /spill

- ❑ Specifications of H8 beamline for low energy applications, including neutrino R&D test beams has been carried out: milestone 27 of AIDA task 8.2.1
- ❑ Doctoral student in place to carry out design study of test beam: deliverable 8.3 in month 26.
- ❑ Instrumentation for test beam (MIND and TASD) in following talk